REMARKS

Upon entry of this amendment, claim 24 and 29 will be canceled, whereby the canceled claims will include claims 1-8 and 24-33. Moreover, claims 19 will be amended, whereby claims 19-23 will remain pending. Therefore, upon entry of this amendment, claim 19 will remain as the sole independent claim.

Applicants note that in order to advance prosecution of the application, and without expressing any agreement or acquiescence with the rejections of record, independent claim 19 has been amended to even further define Applicants' invention in accordance with the originally filed application. Support for the amendments to Applicants' claim 19 appear in the claims and in the specification, including Example 1, Table 1, and the top of page 24. Moreover, the specification is amended herein to explicitly include its recitation in therein. Accordingly, no prohibited new matter is introduced by the present amendment.

Reconsideration and allowance of the application are respectfully requested.

Claim Of Priority

Applicants once again express appreciation for the acknowledgment of the claim of priority as well as receipt of all of the certified copies, which have, in fact, been received in this national stage application.

Discussion Of Telephone Interview

Applicants express appreciation for the courtesies extended by the Examiner during a March 9, 2004 telephone interview with Applicants' representative Arnold Turk wherein the rejections of record were discussed. During the interview, the deficiencies of the rejections set forth in the Office Action were reiterated in the manner set forth in the Amendment Under 37 C.F.R. 1.116, filed November 6, 2003. The Examiner expressed his regret that the rejections set forth in the present Office Action did fully address the arguments set forth by Applicants. The Examiner indicated his opinion that Applicants' invention is rendered obvious by the prior art of record. The Examiner indicated that, upon presentation of further arguments by Applicants and if the rejection was maintained, the position of the Patent and Trademark Office would be more clearly explained while more specifically addressing the various arguments raised by Applicants.

During the interview, arguments were repeated that there is no suggestion or motivation to employ the element on the surface with the scattering of the thickness of the resistance heating body of Masakazu, which is on top of the heater, much less to employ the range as recited in the present claims. It was emphasized that Kiyoshi is directed to an embedded type heater, which is entirely different from the ceramic heater according to the present invention in which the resistance heating body is formed on the surface of the ceramic substrate, and that following Kiyoshi one having ordinary skill in the art would not have been motivated to form the heating element on the surface of the ceramic substrate because it is corroded by plasma. It was further argued that one having ordinary

skill in the art would not have combined the disclosures, and that even if combined the combination would be an embedded heater and not the heater as recited in Applicants' claims. Still further, it was argued that even if a prima facie case of obviousness were deemed to be established the results shown in Applicants' Examples and as argued in Applicants' response would negate any such prima facie case of obviousness. Despite the arguments, the Examiner was not persuaded of patentability of Applicants' invention during the telephone interview, and indicated that he would further review the arguments upon presentation of a written response.

Response To 35 U.S.C. 103(a) Rejections

Applicants note that the following rejections are set forth in the Office Action:

(1) Claims 19-21 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11-040330 to Masakazu in view of JP 11-251040 to Kiyoshi. The rejection once again alleges that Masakazu discloses a ceramic heater with a substrate made of a carbide or nitride ceramic with a thickness of 0.5-5 mm and a resistance heating body formed of a plurality of circuits on a face of the substrate opposite to the heating face. The rejection once again admits that Masakazu does not disclose the scattering of thickness of the resistance heating body to be less than 50%. However, the rejection alleges that Kiyoshi discloses a similar ceramic heater and discloses resistance body thickness dispersion of less than 10%. Therefore, the rejection once again concludes that it would have been obvious to keep the thickness dispersion as small as possible so as to have uniform temperature at the heating face.

(2) Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Masakazu in view of Kiyoshi, and further in view of U.S. Patent No. 5,591,269 to Arami et al. (hereinafter "Arami"). The rejection once again admits that Masakazu does not disclose the resistance heating body formed on the insulating layer. However, the rejection once again alleges that Arami discloses a resistance heating body formed on an insulating layer. Therefore, the rejection once again concludes that it would have been obvious to provide a heating resistance body on top of insulating layer so as not to have short circuiting, specially at high temperature when the resistance of the ceramic base gets low.

(3) Claims 24 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Masakazu in view of Kiyoshi, and further in view of JP 07307377 to Kawada. The rejection once again alleges that Masakazu and Kiyoshi disclose all the recitations of these claims but admits that they do not disclose that the surface roughness of the resistive heating body is to be 0.05-100 μm. However, the rejection alleges that Kawada discloses a surface roughness of a heating layer on a ceramic heater being greater than 5 μm. The rejection also alleges that Masakazu discloses the average thickness of the resistance body to be 1-20 μm and with a 50% maximum, the roughness may be 0.5-10 μm. The rejection further alleges that this falls within acceptable disclosed level of roughness in the claim as well as in Kawada.

In response, Applicants respectfully submit that independent claim 19 is directed to a ceramic heater comprising a ceramic substrate and a resistance heating body formed on a surface thereof, wherein the resistance heating body is formed on a face of the ceramic substrate opposite to a heating face thereof, and a surface roughness of the

resistance heating body is within a range of 0.05 μm - 100 μm as Rmax and not more than 15% of an average thickness of the resistance heating body.

Thus, amongst the features recited in independent claim 19, the claim includes that the surface roughness of the resistance heating body is restricted to 0.05-100 μm as Rmax and not more than 15% of the average thickness of the resistance heating body. Such structure allows adjustment of removal of heat in the atmospheric gas around the resistance heating body to control a scattering of heat generating amount of the resistance heating body to obtain uniformity of the temperature of the heating face.

As discussed throughout Applicants' originally filed application, such as at page 2, the first full paragraph:

> The inventors have made examinations with respect to the aforementioned problem in the technique disclosed in JP-A-11-251040 and confirmed that the reason of ununiform temperature is due to the facts that the distance between the heating face of the substrate and the resistance heating body is too small, and the scattering of the thickness in the resistance heating body is large and/or the surface roughness of the resistance heating body becomes large over a certain standard and as a result the invention has been accomplished. That is, according to the invention, a resistance heating body is formed on a surface opposite to a heating face of a substrate, and the resistance heating body is housed within a particular scattering range and/or a surface roughness of the resistance heating body is adjusted to a particular surface roughness range.

Moreover, the Examiner's attention is directed, for example, to page 4, the first two full paragraphs wherein it is disclosed that:

> And also, when the surface roughness of the resistance heating body is less than 0.05 μm as Rmax, the surface is too smooth and an atmosphere gas is easily fluidized and locally gets heat of the resistance heating body and hence the temperature of the heating face for the wafer or the like becomes easily ununiform. While when the surface roughness exceeds 100 μm as Rmax, the thickness of the resistance heating body becomes scattered and the temperature of the heating face for the wafer or the like becomes ununiform. That is, when the surface roughness of the resistance heating body is too large or too small, the temperature of the heating face can not be uniformized.
>
> In other words, the reason why the scattering and surface roughness of the thickness of the resistance heating body are adjusted is to prevent the fact that when they exceed upper limits, the scattering of the resistance value of the resistance heating body becomes large and hence the scattering of the temperature distribution of the heating face for the wafer or the like becomes large.

Applicants note that when Rmax is less than 0.05 μm the atmospheric gas flows to remove heat and hence a drop in temperature is caused. Moreover, when Rmax exceeds 100 μm, the scattering of the thickness of the resistance heating body becomes large and the temperature of the heating face becomes non-uniform. Further, when the surface roughness exceeds 15% of the average thickness, the scattering of the thickness of the resistance heating body becomes large and the temperature of the heating face becomes non-uniform.

With respect to the above, the Examiner's attention is directed to the Examples and Comparative Examples set forth in Applicants' specification. In Example 1, the surface roughness of the resistance heating body is 0.5 μm as Rmax and 15% of the

average thickness, while in Comparative Examples 2 and 3, the surface roughness of the resistance heating body is 65% and 0.8% of the average thickness and 130 μm and 0.04 μm as Rmax, respectively. Also, the temperature difference of the heating face is 5°C in Example 1, 15°C in Comparative Example 2 and 10°C in Comparative Example 3, respectively.

From these results, it is seen that the temperature difference of the heating face is controlled in Example 1 as compared to the Comparative Examples. Further, in Example 3, although the surface roughness of the resistance heating body is 1.0 μm as Rmax, the temperature difference is as large as 6°C since the scattering of the thickness is 30%. As mentioned above, according to the present invention, the uniformity of the temperature in the heating face is improved by adjusting the surface roughness of the resistance heating body (Rmax and scattering of thickness).

As previously mentioned, Masakazu discloses a heater in which a heating body formed by sintering metallic particles is arranged on a plate body of nitride ceramic or carbide ceramic, and also discloses printing of a conductor paste on the plate-shaped ceramic and heating. However, Masakazu does not disclose adjusting the thickness of the heating body and surface roughness. Therefore, a surface roughness of the resistance heating body being within a range of 0.05 μm - 100 μm as Rmax and not more than 15% of an average thickness of the resistance heating body is not taught or suggested in Masakazu.

Furthermore, Example 1 of Masakazu substantially corresponds to Comparative Example 1 in which with respect to the average thickness of 5 μm, Rmax is 3.5 μm and is more than 50% (2.5 μm) of the average thickness. In Comparative Example 1, the temperature difference is as large as 10°C, so that the temperature uniformity of the heating face is poor as compared with that of Example 1.

Masakazu discloses that the average thickness of the resistance heating body is 1-20 μm, but does not teach or suggest the surface roughness of the resistance heating body, whereby Masakazu is silent with respect to any effect of attaining temperature uniformity of the heating face by adjusting surface roughness.

From the above, it is apparent that the present invention solves the problem inherent to the invention disclosed in Masakazu and there is no teaching or suggestion to arrive at Applicants' invention from Masazaku, especially when Masazaku does not teach or suggest the problem and/or any solution thereof.

The deficiencies of Masazaku are not overcome by the remaining documents utilized in the rejections.

Initially, Applicants note that in view of the diverse disclosures of the documents utilized in the rejection one having ordinary skill in the art would not have been motivated to combine their disclosures in any manner to arrive at Applicants' invention. Moreover, even if the disclosures were combined, Applicants' invention would not be at hand.

For example, Kiyoshi discloses a ceramic heater corresponding to Comparative Example 4 of the present invention. As previously noted by Applicants, the heater of Kiyoshi is poor in temperature uniformity of the heating face as compared with the heater according to the present invention because the distance between the heating body and the heating face is short and a high-temperature region similar to the heating body pattern is apt to be caused in the heating face.

In Comparative Example 4 of the present invention, AlN is added with yttria to prepare a green sheet. Kiyoshi discloses the production of a ceramic green sheet in paragraph [0030]. Also, tungsten carbide is printed on the green sheet in Comparative Example 4, while Kiyoshi discloses in paragraph [0031] that the heating body is formed by using a paste of electrically conductive ceramic powder. Further, the green sheets are laminated and fired at 1890°C in Comparative Example 4, while Kiyoshi discloses in paragraph [0042] that the firing is carried out. at 2019°C. Therefore, Kiyoshi substantially corresponds to Comparative Example 4 in Applicants' specification.

In Comparative Example 4, the temperature difference on the heating face is as large as 13°C, while those in Examples 1, 2 and 5 according to the present invention are within 2°C.

Further, the temperature difference in Example 1 is the smallest as 1.4% (=7/500 x 100) among Examples at the temperature of 500°C, while that in the present invention is 1.25% (=5/400 x 100) as the maximum value at the temperature of 400°C.

Accordingly, the present invention is superior in the temperature uniformity to Kiyoshi. Applicants therefore respectfully submit that one having ordinary skill in the art would not have been motivated to have combined the disclosures of Masazaku and Kiyoshi. Moreover, even if for the sake of argument, the disclosures were combined, the presently claimed invention would not be at hand.

Thus, Kiyoshi is concerned with the inner layer heater, which corresponds to Comparative Example 4. Therefore, Kiyoshi is entirely different from the present invention. Moreover, there is no suggestion or motivation to employ the element on the surface with the scattering of the thickness of the resistance heating body of Masakazu, which is on the top of the heater, much less to employ the range as recited in the present claims.

Arami discloses a technique that the insulating layer 23 is formed in the substrate 22 of ceramic such as BN and the heating body 26 is further formed thereon. However, Arami does not teach nor suggest any control of thickness scattering of the heating body.

Arami discloses at column 24, lines 55 to 65 that the heater 26 is wired by CVD (chemical vapor deposition) process. Since CVD process is a technique wherein the starting gas is subjected to chemical reaction treatment such as thermal decomposition to deposit the resulting reaction product, it is impossible to control the average thickness of the thickness scattering to not more than 50% unless the thickness is controlled after the deposition. In Arami, the control of the thickness is not conducted after the formation of the heating body through CVD process, so that the temperature uniformity of the heating

face is poor as compared with that of the present invention. Accordingly, it would note have been obvious to one having ordinary skill in the art to combine the disclosure of Arami with the disclosure with any combination of Masakazu and Kiyoshi, and, even if combined, the presently claimed invention would not be present.

Kawada discloses the heating body of Rmax = 5 μm at column 4, line 37, but does not teach or suggest hat Rmax is made to what extent of the thickness of the heating body. Further, Kawada does not recognize that when Rmax exceeds 15% of the thickness, the scattering of the temperature in the heating face is large.

Kawada discloses a ceramic heater provided with an electrostatic chuck wherein an electrode for electrostatic chuck made of an electrically conductive ceramic is joined onto a front surface of a support substrate made of an electrically insulative ceramic and a heating layer made of an electrically conductive ceramic is joined onto a rear surface thereof and further a coating layer made of an electrically insulative ceramic is formed thereon provided that surface roughness Rmax of each of the support substrate, electrode and heating layer is not less than 5 μm. As described in [0005], the reason why the surface roughness Rmax is limited to not less than 5 μm is due to the fact that is it desired to improve the adhesion property between the heating layer and the coating layer, which is different from the temperature uniformity of the heating face.

Moreover, Kawada does not teach nor suggest any control of thickness scattering of the heating layer.

Still further, Kawada discloses in claim 3 that the heating layer is formed by chemical vapor deposition process such as in Arami.

Therefore, it is seen that any combination of the documents utilized in the rejections of record do not teach or suggest a ceramic heater comprising a ceramic substrate and a resistance heating body formed on a surface thereof, wherein the resistance heating body is formed on a face of the ceramic substrate opposite to a heating face thereof, and a surface roughness of the resistance heating body is within a range of 0.05 μm - 100 μm as Rmax and not more than 15% of an average thickness of the resistance heating body. Moreover, Applicants' invention achieves advantageous results that are not taught or suggested in the documents utilized in the rejections.

Moreover, claim 20 further patentably defines that the ceramic substrate is a carbide or nitride ceramic.

Still further, claim 21 further patentably defines that the ceramic substrate has a thickness of not more than 25 mm.

Still further, claim 22 further patentably defines that an insulating layer of an oxide ceramic is formed on the surface of the ceramic substrate and the resistance heating body is formed on a surface of the insulating layer.

Still further, claim 23 further patentably defines that the resistance heating body is constructed by two or more circuits.

According, the rejections of record are without appropriate basis and should be withdrawn.

CONCLUSION

In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw the rejection of record, and allow each of the pending claims.

Applicants therefore respectfully request that an early indication of allowance of the application be indicated by the mailing of the Notices of Allowance and Allowability.

Should the Examiner have any questions regarding this Response, the this application, the Examiner is invited to contact the undersigned at the below-listed telephone number.

Respectfully submitted,
Yasuji HIRAMATSU et al.

Bruce H. Bernstein
Reg. No. 29,027

July 15, 2004
GREENBLUM & BERNSTEIN, P.L.C.
1950 Roland Clarke Place
Reston, VA 20191
(703) 716-1191